

R E P O R T R E S U M E S

ED 011 107

AL 000 057

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FUB DATE 4 SEP 66

EDRS PRICE MF-\$0.09 HC-\$0.64 16P.

DESCRIPTORS- *PSYCHOLINGUISTICS, *SEMANTICS, *COGNITIVE PROCESSES, *RETENTION, PSYCHOMETRICS, RETENTION STUDIES, NEW YORK CITY

CONDITIONS OF SEMANTIC SATIATION WERE INVESTIGATED, WHICH LEAD TO "LAPSE OF MEANING" IN THE PRESENCE OF VERBAL REPETITION. RATE AND AMOUNT OF REPETITION AFFECT THE SHAPE OF THE MEANING CURVE, AND VERBAL REPETITION OF A DETERMINED AMOUNT AND RATE MAY GENERATE VARYING AMOUNTS OF REACTIVE INHIBITION WHEN INDIVIDUAL DIFFERENCES ARE CONSIDERED. THE PROBLEM WAS ONE OF SPECIFYING THE CONDITIONS UNDER WHICH SATIATION AND GENERATION WILL OCCUR, AND TO EXPLAIN WHY IN A THEORETICALLY CONSISTENT FASHION. SEMANTIC SATIATION IS ASSUMED TO BE MEDIATED BY SUSCEPTIBILITY TO CORTICAL FATIGUE AND BY THE CHARACTERISTIC RATE OF OSCILLATION OF THE INDIVIDUAL'S ATTENTIVE PROCESS. AGE AND INTELLIGENCE ARE LIKELY CORRELATES OF THE ATTENTIVE OSCILLATION RATE. THE EFFECTS OF SEMANTIC SATIATION IN COGNITIVE PROCESSES SUCH AS PROBLEM SOLVING, CONCEPT FORMATION, AND VERBAL LEARNING LEAD TO THE CONCLUSION THAT A GENERAL AND BASIC CHARACTERISTIC OF CORTICAL ACTIVITY IN MENTAL PROCESSES IS INVOLVED. THIS PAPER WAS PRESENTED AT THE ANNUAL CONVENTION OF THE AMERICAN PSYCHOLOGICAL ASSOCIATION (NEW YORK, SEPTEMBER 4, 1966). (KL)

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SEMANTIC SATIATION AND COGNITIVE DYNAMICS*

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When the phenomenon of semantic satiation was first reported in the literature around the turn of the century by investigators working in Titchener's laboratory, it was described as a curious and isolated effect referred to as "lapse of meaning." Today, we have reasons to believe that semantic satiation, and its complementary effect referred to as semantic generation, represent an important property of cognitive activity and are intimately related to cognitive functioning in general. In this paper I would like to summarize the evidence consonant with this position and outline the role of semantic satiation and generation in cognitive dynamics.

Prior to 1960, when Professor Lambert of McGill University and I reported in the Journal of Experimental Psychology, a new technique for the measurement of semantic satiation which makes use of the semantic differential instrument, the phenomenon of lapse of meaning was thought of as an all or nothing effect. This view was a consequence of the Titchener method of measuring the effect which consisted of determining the moment at which the meaning of a word would lapse while the S repeated the word out loud or silently to himself. The word would be repeated until, by some suitable and prearranged signal, the S would indicate to the experimenter the introspective moment of meaning lapse. Using this method, contemporary investigators discovered that some words retain their meaning longer than other words, and that for some subjects it took longer for the meaning of specific words to lapse than for other Ss.

One result of the use of the semantic differential technique to index the effects of verbal repetition on the meaning of words was to introduce the notion of decrease in the intensity of meaning as distinguished from the earlier notion of total meaning

* Paper presented at the Annual Convention of the American Psychological Association in New York, September 4, 1966.

lapse. Using the polarity-difference score we could determine the amount of meaning a word lost after a given period of repetition. The use of the semantic differential technique to study the phenomenon of semantic satiation was consonant with our theoretical position concerning the nature and measurement of meaning. Earlier, Titchener, and more recently, Professor Michael Wertheimer of the University of Colorado, viewed lapse of meaning with verbal repetition as a consequence of the dissociation between the meaningless sounds and the core meaning ordinarily attached to them. This dissociation supposedly came about as a result of repeatedly apperceiving the word in isolation and out of context of normal usage. Thus for example, Wertheimer has argued that words whose sounds fit their meaning, such as appears to be the case with onomatopaea, should retain their meaning longer under conditions of verbal repetition than words not having this characteristic. Quite distinguishable from this perceptual-gestalt approach is our interpretation of semantic satiation as an inhibition-extinction process related to the elicitation of representational mediation reactions identified with the meaning of words. According to this view, verbal repetition is accompanied by repeated and continued elicitation of representational mediation responses; the reactive inhibition which is thus generated temporarily reduces the intensity of the meaning response. At the same time, extinction of the learned meaning habit may take place, depending on the conditions of repetition. In this paper I intend to speculate not only on the nature of these conditions, but also on the consequences of these extinctive effects on cognitive activity.

First, however, I would like to comment on a controversy sparked by a paper by Yelen and Schulz published in the *Journal of Verbal Learning and Verbal Behavior* in 1963, followed up by another critical note by Schulz, Weaver, and Radke which appeared in *Psychonomic Science* in 1965. A formal rebuttal to these two papers is now in press in the *Journal of Verbal Learning and Verbal Behavior* and therefore, I will limit my remarks here to the major point at issue, especially since Professor Amster has already reported our rebuttal in her *Psychological Bulletin* article of 1964.

I have already mentioned that we are using the polarity-difference score as the index of the change in the intensity of meaning that accompanies verbal repetition. It seems to me that if one chooses to make use of the semantic differential technique in the measurement of meaning one cannot simply disregard the mathematical properties of this rating instrument. These properties impose certain logical restrictions on the manipulations that are permissible with the data thus obtained. A primary requirement of the semantic differential technique as developed by Osgood and his associates is

that the selection of scales not be random. Years of research have established the existence of three independent factors of affective meaning, and to my view, it makes no good sense to disregard this evidence by lumping together semantic differential scales in such a way as to completely disregard the independence of the factor structure of semantic space. The scoring system which Schulz and his associates have adopted to index changes in meaning accompanying verbal repetition disregards and violates the theoretical properties of the semantic differential. In essence, the problem consists of determining what is to be considered as error variance and what is to be considered true difference in meaning. Differences in ratings on scales drawn from the same factor can be treated as error variance and therefore a mean difference score may be computed to achieve greater reliability. Differences in ratings on scales drawn from different factors should properly be treated as true differences and may not be amalgamated or dissipated by computing a mean difference score. Similarly, if one is interested in group profiles, greater stability can be achieved by considering individual differences as error variance and computing a mean difference score as long as scales from the same factor are used. But in no case should a mean difference score be computed on scales drawn from different factors. Suppose you were interested in making comparisons between U.S. and Japanese currency by using the two measures of size and value of the coins. Think what would happen if you lumped together these two independent measures by means of a mean difference score; the comparison between the U.S. and Japanese coins based on such a mean score would be meaningless. I have already demonstrated mathematically that polarity changes based on the mean difference score can lead to patently wrong conclusions.

It is for these same reasons that I find myself in disagreement with the position taken by Professor Amster in her Psychological Bulletin review. Although she describes and recognizes the distinction between the polarity-difference score and the mean difference score, Professor Amster contends that the mean difference score remains a useful measure of what she calls "consistent generation." This is defined as the tendency for ratings on a particular scale to change consistently toward the positive or the negative pole of the scale. Thus both positive and negative generation are specified. I must confess that I do not comprehend the scoring technique described in her paper. The numerical example given in the explanation was taken from my paper with Professor Lambert which outlined our rebuttal to Yelen and Schulz and consists of an initial pre-repetition mean score of 4.00 (viz. the neutral point on the scale) and a final post-

repetition score of 4.67, giving us a mean difference score of 0.67. Professor Amster then makes the following puzzling statement: "This would be called generation since the mean of the scores was above neutral at the outset. If the mean had been below neutral at the outset, it would have been called satiation" (p.276). Well, in the first place, the mean at the outset in this particular example is right on the neutral point and not above it. And in the second place, even if the mean had been below neutral at the outset, it could still indicate generation, as long as it remains closer to the neutral point than the mean final score. In other words, the determination of satiation and generation as Yelen and Schulz use the mean difference score has nothing to do with whether the initial mean score is above or below the neutral point, but only with the relative position of the initial and final scores with respect to the neutral point. This is quite clearly shown in Table 3 of their Experiment IV in which they report the results for the so called satiation and generation scales. Thus, for their satiation scales, the mean initial score is 2.38 and the mean final score is 2.49. The mean difference is interpreted as satiation because the final position is closer to the neutral point than the initial position. Similarly for their generation scales, the mean initial score is 3.35 and the mean final score 3.25. This mean difference score is interpreted as generation because the final score is further away from the neutral point than the initial score. Note, incidentally, that all four points are below the neutral point.

Apart from the mathematical difficulty with so called consistent generation, there seems to me to be also a theoretical difficulty. As it has been defined it obliterates the distinction between satiation and generation inasmuch as it is no longer related to an increase or decrease in intensity of meaning. The following illustration will explicate my point. Suppose an initial mean score of 6 (viz. "quite bad") on the "good-bad" scale; now, take three separate instances of so called positive generation as defined by Professor Amster, namely final scores of 3, 2, and 1, respectively. In terms of polarity or intensity of meaning, the three shifts represent respectively, a decrease, an increase, and no change; yet, all three are equated under the definition of "consistent generation." I find it difficult therefore to accept Professor Amster's concept of "consistent generation" as being related to either my own definition of semantic satiation and generation, or, for that matter, to that of Yelen and Schulz.

At this point I would like to go on to some theoretical speculations on the role of semantic satiation and generation in more general aspects of cognitive activity. There are people who somehow seem uneasy with both semantic satiation and generation around, but there is no valid reason to suppose that the two are contradictory phenomena -- no more so than inhibition and disinhibition, or even, conditioning and extinction. Note that in the latter case, both conditioning and extinction are consequences of the repeated elicitation of the S-R habit cycle. I have referred elsewhere to a frequency hypothesis which is graphically represented as an inverted U curve with the frequency dimension on the abscissa and intensity of response on the ordinate dimension. The first half of the curve showing a negatively accelerated increase in intensity of response with increased repetition resembles the well known learning curve and has been identified with semantic generation. The second half of the curve a positively accelerated decrease in intensity of response with further increase in repetition is identified with semantic satiation. The region separating the two halves can be referred to as the critical region and contains the critical point where the curve changes inflection and marks the change from semantic generation to semantic satiation. I assume that the shape of this frequency curve which I shall also call the meaning curve, and the locus of the critical point vary with the conditions of repetition and the nature of the response involved. Let me speculate a bit on this by specifying some of the factors that determine the shape of this curve.

Since I hold that an immediate antecedent of semantic satiation is the development of cognitive reactive inhibition specifically related to the representational mediation response identified with the stimulus word that is being repeated, both rate and amount of repetition ought to affect the shape of the meaning curve. What is less obvious is that verbal repetition of a determined amount and rate may generate varying amounts of reactive inhibition when individual differences are considered. There are two factors to be considered here. One is related to individual differences in susceptibility to biochemical fatigue of the cortical cells involved in repeated firing of cell assemblies in cognitive activity. The other is related to an attentional factor connected with an individual's capacity to focus persistently on the word that is being repeated. I have referred to this elsewhere as the oscillation hypothesis to emphasize the variable nature of the attentive process. As is well known, it is possible to engage in echoic behavior such as automatic reading during prayer or during moments of so called absent

mindfulness, without paying attention to or comprehending what is being read. We have here an instance of a perceptual-motor skill with, as Osgood has put it, "the representational system being temporarily disconnected." A S who repeats a word out loud while thinking about something else is in effect by passing the representational meaning system and little reactive inhibition of the meaning response is to be expected. Under these circumstances, the simple relationship between amount and rate of verbal repetition and semantic satiation should not hold. In 1960 Professor Lambert and I pointed out that "In order to satiate the meaning of a symbol through continuous repetition, some particular cognitive activity which is related to the symbol must consistently be called into play" (p. 382). One can easily imagine that given an oscillation pattern during verbal repetition between moments of effective elicitation of the meaning response and moments of short-circuiting it, a facilitative effect may ensue which would result in semantic generation. I have often puzzled over the finding we reported elsewhere that with 15-sec. repetition periods and rates of repetition of 2 to 3 per sec., we obtain the following distribution of meaning change scores: about 65% of the ratings are of the semantic satiation type, about 25% are of the semantic generation type, and about 10% do not change. It now occurs to me that these ratios may represent the typical oscillation pattern in attention for most Ss under these experimental conditions. By using proper instructions and simultaneous tasks involving competing attentional sets it should be possible to manipulate experimentally the consistency with which a specific representational process is elicited during verbal repetition. The ratio of semantic changes obtained under these conditions would constitute a direct test of the oscillation hypothesis as here presented.

There is still a further factor that may have to be taken into account under conditions of verbal repetition. Professor Amster's interpretation of semantic satiation in terms of adaptation level theory points to the possibility of a shift in the customary meaning of a word due to its repetition. Osgood has previously referred to the problem of denotative contamination in the use of semantic differential scales such that certain bi-polar adjectives may shift their meaning when used with certain concepts. For example, the meaning of the scale "hard-soft" when used with such concepts as CHARACTER, MUSIC, or PRIDE is not the same as when used with such concepts as DIAMOND, PEACH, or BLUEBERRY PIE. In this case what happens is a shift from a metaphorical to a denotative use of the scalar opposites. It was Professor Miron, now at Syracuse University, who first suggested to me that an analogous shift in concept meaning can occur during verbal

repetition. In an extreme case such shifts could bring about the situation where the word being rated after repetition is no longer the same word that was rated before repetition. More probably, however, different affective and denotative features of the word become salient. Changes in the customary word association responses under conditions of verbal repetition of the stimulus word have been noted by some investigators and these findings can be construed as evidence for such concept meaning shift. In the case of semantic differential ratings such shifts in concept meaning may result in a re-orientation of both the meaning of scalar adjectives as well as in their relevance to the concept. Pyke has demonstrated that with the repetition of high meaningful words the number of relevant meaning dimensions decreases, whereas with the repetition of low meaningful words there is an increase in the number of meaning dimensions that become relevant.

It is interesting to speculate on the effect of the concept-scale interaction upon the semantic differential profile. There is reason to believe that, under ordinary conditions of semantic differential ratings, the profile will reflect the componential resultant of the various fractionary meanings of the concept that is being rated. It is also likely that the fractionary meanings are differentially loaded in a habit hierarchy so that some one meaning is ordinarily dominant. With verbal repetition a shift in the customary habit hierarchy may occur such that different fractionary meanings become dominant. The profile should reflect this change by moving away from the pre-repetition point. One possibility is that repetition reduces the dominant affective component of a symbol and raises the importance of antagonistic components - a situation which would result in neutralization of the resultant factor score. Another possibility is that the components which become dominant are affectively more pronounced (in the same direction) - a situation which would result in polarization of the resultant factor score. Finally, it may be that irrelevant and mutually antagonistic affective components become dominant as a result of verbal repetition - once again resulting in neutralization of the profile.

It is apparent that the picture that I am drawing here is considerably more complex than the original version of 1960. Some critics will no doubt claim that the present version is incompatible with the earlier one, but I don't think this is so. In a previous report I pointed out that the direction and strength of semantic change under repeated presentation of a stimulus may be a function of the total number of representational mediation processes which can potentially be elicited during inspection or

repetition of the stimulus. I argued that, if this number is large, the strength and number of mediation processes which are elicited will increase, promoting semantic generation; whereas, if the number is relatively small, repeated elicitation will lead to a decrease in strength due to the accumulation of neural reactive inhibition, promoting semantic satiation. It is thus apparent that both the concepts and the scales used would affect the type of semantic changes that may occur under conditions of verbal repetition. It is not beyond my imagination to conceive that a judicious choice of concept-scale combination can yield either generation or satiation as Yelen and Schulz have suggested, although not, I think, adequately demonstrated. The real problem is to specify the conditions under which satiation and generation will occur - and to explain why in a theoretically consistent fashion.

Now I would like to go on with a discussion of personality traits related to semantic satiation. Other writers, as early as Pavlov and more recently, Eysenck and Michael Wertheimer, have speculated on the behavioral effects of personality traits related to susceptibility to cortical inhibition. Although the literature on this matter is disappointingly replete with negative findings, some recent reports by Das, Smith and Raygor, Spitz, and others, as well as some as yet unpublished evidence from our own laboratory, may force us to reexamine this relationship with perhaps a more positive outcome. According to my assumptions, this personality trait, that I have previously called semantic satiability, is mediated by susceptibility to cortical fatigue and by the characteristic rate of oscillation of the individual's attentive process. Thus, Warren's finding that old people show greater stability of verbal transformations under auditory repetition, and some recent evidence of our own showing that younger children are less susceptible to semantic satiation than older children, may point to a developmental ontogenesis of the attentive oscillation pattern such that the very young and the very old have a more varying and less stable oscillation pattern than individuals of intermediate ages. The persistent popular concept of "power of concentration" may yet be vindicated by scientific investigation if these speculations have any empirical validity. Both age, as I have pointed out, and intelligence, are likely correlates of the attentive oscillation rate. The various demonstrations previously reported of the effects of semantic satiation in cognitive processes such as problem solving, concept formation, retention, verbal learning, auditory perception, verbal conditioning, and so on, which I shall not review here, reinforce me in the belief that we are dealing here with a general and basic characteristic of cortical

activity in higher mental processes.

There is an aspect of semantic satiability which needs further clarification and on which I would like to comment now. This is the problem of the specificity of the cognitive process that is said to be satiated. When I interpreted some findings on the changes in the popularity of Hit Parade songs in terms of the concept of semantic satiation, one critic objected on the grounds that this represented a gratuitous extension of the concept as originally proposed in the case of repetition of single words. This question is particularly relevant in some recent work in which we investigated the effects of repetition in tape recorded messages, in educational films, in fads, and in sentential materials. I think the answer lies in the property of higher mental processes to organize themselves into a converging system of habit-family hierarchy representing units of increasing abstraction. After all, precise analysis of the meaning of a word immediately reveals that we must be concerned with a whole set of individual responses organized into a habit-family. The meaning response we represent as " r_m " is obviously a compound resultant of a series of more specific responses which theoretically correspond to individual scales of the semantic differential. Similarly one can conceive of a unitary response to a Hit Parade song without contradicting the notion that it is composed of individual responses of a more fractional nature. The belief that the whole is more than the sum of its parts affects the present argument only in so far as one attempts to make statements about the generalization of satiation from the more abstract unitary response to the more fractional part responses of which it is made up, -- and vice versa. For example, when a sentence loses meaning because it has been repeated too often, such as might be the case with overwrought cliches, to what extent are the phrases and words making up the cliché also satiated? In an experiment now in progress, Professor Osgood, Ultan Rice, and I are investigating possible satiation effects in the use of certain grammatical features that continuously recur in normal language use. The obvious resistance to satiation of grammatical rules repeatedly used in speech points to the existence of protective cortical mechanisms that function to inhibit satiation effects under conditions of excessive repetition. This mechanism may involve direct inhibitory cells of the type suggested in another context by Milner, or it may involve a system of alternating reverberatory phase sequences of the type postulated by Hebb, again in another context. Think of the annoying persistence with which a particular tune intrudes itself by constant repetition

in one's thought processes and resists any attempt on the part of the individual to suppress it. This kind of failure of satiation where it ought to occur stands in sharp contrast to other everyday happenstances where its effects are quite predictable. How many of you in this room are able to draw even a reasonably accurate representation of the face of your wrist watch after having looked at it for thousands of times?

But there is still a further possibility which suggests itself by the observation that certain forms of behavior can endlessly be repeated without any reduction in their intensity. In normal behavior this type of repetition is associated with automated behavior in which the representational process seems to have been short-circuited as in the example I gave earlier with automatic reading. Where this form of repetition shows itself in higher mental processes, it is associated with abnormal behavior as in echolalia and certain obsessive-compulsive thought patterns notable in some mental disorders. What I am suggesting then is that the application and use of grammatical rules in normal adult speech may have reached an automated level that bypasses the representational system and may be dependent upon a type of lower level cortical activity that is resistant to satiation effects.

I would like to end my comments by suggesting certain possible applications of the semantic satiation effect in a number of areas. When Wolpe first described his method of systematic desensitization in the treatment of phobias, I immediately saw in it, as you may expect by now, semantic satiation at work, and when subsequent investigators corroborated the efficacy of this treatment method, I began to think more seriously about other possible applications in behavior change. I have described elsewhere a procedure by which semantic satiation principles could be used in the treatment of stuttering, and although I have not myself verified their efficacy, I was gratified by the warm reception given my suggestions by some speech therapists. In principle, semantic satiation as an applied tool ought to work wherever some specifiable cognitive activity mediates some behavior that one wishes to alter. If, for instance, as may be the case for some stutterers, the speech disorder is mediated by negative evaluational reactions to specific words or to the speech situation, then the behavior can theoretically be altered by satiating the evaluational reactions that mediate it. Similarly, if one could first identify, then satiate, the affective responses that mediate discriminatory behavior, one ought to be able to change such behavior more easily than otherwise. The notion that behavior can be changed by

reorienting cognitive activity is not, of course, novel as psychotherapists, educationists, and propagandists well know. What is novel is the suggestion that the cognitive reorientation can be achieved by repeated and continued elicitation of the individual's habitual mode of thinking. The advantage of this approach lies in the obvious fact that it is easier to elicit an individual's habitual response than it is to suppress it. When my wife wanted to stop smoking, she went on a smoking binge for two weeks until, as she put it, she was so satiated that she could quit the habit for good. (To this day she doesn't smoke.) At one period during my adolescence I developed such a raging liking for the movies that, to the distress of my parents, cinema going became a daily event for me. I found I could reduce my movie attendance and thereby save time and money, by picking the odd Sunday and attending four or five performances on the same day. That satiated me for weeks after. But eventually the desire came back, but this is as far as the method can go by itself. Satiation is subject to dissipation and extinction has to contend with spontaneous recovery. Preferably, some form of counter-conditioning ought to be used at the point of deepest satiation.

In conclusion, I would like to say that what I have attempted to do was to allocate a fundamental role to the operations of semantic satiation and generation in cognitive activity viewed within a Hullian behavior system. The significance that I attach to this attempt does not lie so much in its truth value -- after all, most theories have a life span which is very short or moderately long, but seldom very long -- but rather in its consistency of approach to a wide variety of human behavior. I think it is possible to give a number of plausible alternatives to the interpretation of a decrease or increase in the polarity of rating on the semantic differential scale, but I challenge these alternative interpretations to give a consistent account of the range of facts which this theory of semantic satiation and generation has incorporated.

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